

## Appendix I. EQUIPMENT

<i>Equipment List</i>	<i>Quantity</i>
Radiation detection meters .....	1 to 6
Personal dosimeters .....	1 per person
Water .....	100 gals. (Minimum)
Scrub brushes (long handles) .....	1 to 6
Detergent, solvent, or soap .....	2 to 4 lbs.
Protective clothing .....	1 complete outfit for each member of monitoring and decontamina- tion teams.
Atom-marker signs .....	10 to 12
Arm bands .....	1 per person
Vacuum cleaner .....	1 (required only for advanced classes)
Aircraft .....	1
Contaminant (simulating fallout) .....	10 lbs.
Water pails .....	1 to 4

**1. RADIATION DETECTION METERS (GEIGER COUNTERS).** For a practice exercise, the Civil Defense low-range model CD-V-700 (0-50 mr/hr.) is recommended. The military equipment is model AN/PDR 27 or 27A. It is necessary to have a minimum of one Geiger counter. If possible, borrow several counters, so that more people can be given the opportunity to learn how to use them. Arrangements should be made to borrow these instruments from one of the following sources:

- a. Federal Aviation Agency station or tower.
- b. Department of Defense Installation (Army, Navy, Marines or Air Force).
- c. Weather Bureau.
- d. Civil Defense Unit (county or local).
- e. High School or College Science Department.

**2. PERSONAL DOSIMETERS.** Low-range picket-type dosimeters may be borrowed (from the

same sources) for each person in the group. The Civil Defense model DC-V-138 is the equivalent to military model No. IM-9. These dosimeters are preferable to the film-badge type only because they are self-reading. A dosimeter charger, Civil Defense model CV-V-750, is necessary in order to reset the dosimeter hairline to zero or to bring the line onto the scale so that a starting and ending reading can be taken.

**3. WATER.** As far as possible, water used for decontamination purposes should be clean or free of contamination. If, at your airport, it is necessary to use water pumped from an open body supply, place the intake end of the hose 1 or 2 feet below the surface, but not on the bottom. Fallout which descends on open water will either sink to the bottom (heaviest particles) or float on the surface (lighter dust). If water is obtained from a tank or covered well,

it will probably be free of contamination. Local fire trucks equipped with tanks may be available, which would greatly simplify the water problem for this exercise.

**4. SCRUB BRUSHES.** Any fiber brush will be satisfactory, provided it has a long handle. Fairly soft bristles and a good size brush-head, 2½ or 3 inches by 8 or 10 inches, are preferable.

**5. DETERGENTS, SOLVENTS, OR SOAPS.** Ordinary soaps and detergents found in any grocery store are satisfactory. Where fallout has been embedded in or adheres to an oily or greasy spot, the addition of soap to the water will greatly increase the efficiency of decontamination work. Although it is unlikely that heated water or a steam jet will be available, they are both very effective in removing grease and oil.

**6. PROTECTIVE CLOTHING.** This is the most important of all the equipment needed for your exercise. **IF YOU CANNOT PROTECT YOUR PERSONNEL WITH WATERPROOF CLOTHING, DO NOT ATTEMPT THE EXERCISE.** However, it is neither difficult nor expensive to obtain the clothing required for adequate protection.

The following items must be included:

waterproof boots

waterproof suit with hood (hip boots and a slicker type raincoat and a separate hood

can be substituted)

rubber gloves (waterproof fabric gloves can be substituted, but do not take chances on contamination soaking through to your skin)

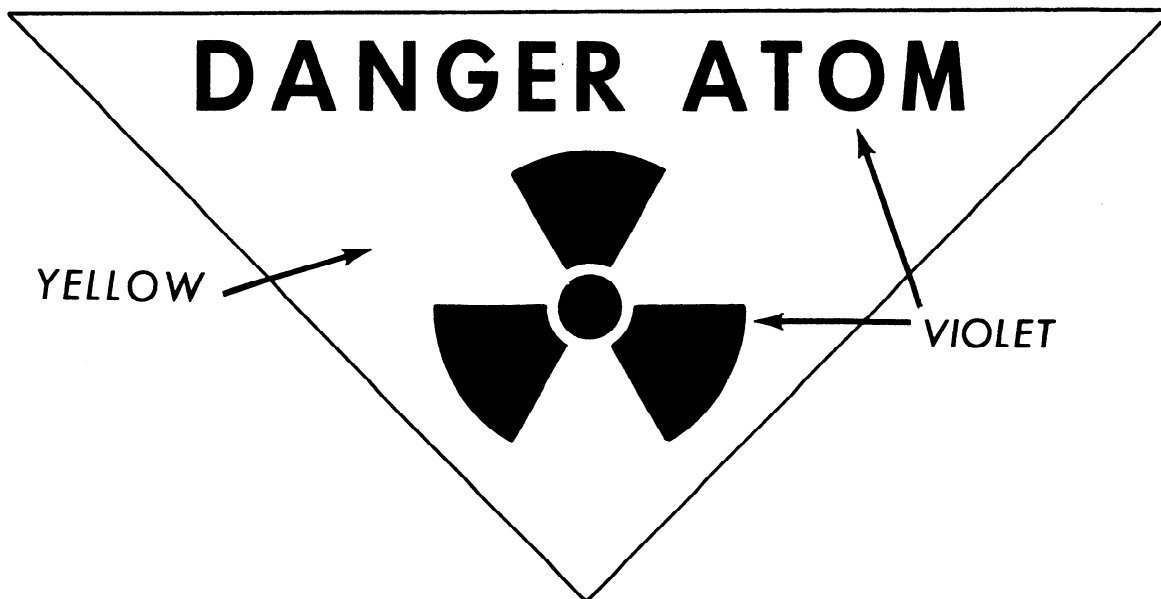
protective face mask

Use 2-inch wide masking tape or waterproof adhesive tape to seal clothing joints at ankles, wrists, waist, neck, and to cover zippers and close any other openings where moisture might possibly penetrate the protective clothing.

**7. ATOM-MARKER SIGNS.** The control of contamination, which is a major problem, can be materially assisted by "fencing off" specific areas. Remember that contamination can be spread by tracking on shoes. Vehicles can also track contamination from one area to another. Valuable and much needed equipment could be out of service for long periods if carelessly or unnecessarily driven into contaminated areas.

a. The purpose of the atom-marker signs is to assist in controlling the spread of contamination. The signs should constitute sufficient warning to stop people from wandering into a "hot" area and returning to "clean" areas, which would result in cross-contamination.

b. The signs may be handmade, but they should follow the approved Department of Defense design and dimensions as closely as possible.



The prescribed shape is a right-angle isosceles triangle with a base having a minimum length of 6 inches. The quantity of signs required will depend on the size of the area you wish to designate as a "hot" area. Signs should be placed 20 to 30 feet apart, to minimize the possibility of people walking into the area without observing at least one of the markers. Signs should be mounted on stakes, standards, or may be suspended from a rope barrier if used. The surface on each marker should face away from the contaminated area. Signs are of little or no value if placed flat on the ground.

**8. ARM BANDS.** If you have a large group, it is advisable to provide identifying colored arm bands for each team. Otherwise it is almost impossible to identify people when they are "suited out" in full protective clothing. The team leaders should be given a distinctive identification such as a double arm band. Reflective tape can be used for night operations.

**9. VACUUM CLEANER.** This is not a required piece of equipment, at least for the first few exercises. However, when you are prepared to practice interior decontamination, the vacuum cleaner will be a very handy tool. A portable source of electrical power will be necessary if a vacuum cleaner is used.

**10. AIRCRAFT.** It is suggested that a small aircraft be used for the exercise until the basic lessons have been learned. The contaminated sand will not damage the aircraft and all traces of radioactive material should be removed during the exercise so there will be no danger to

personnel operating or working on the aircraft at a later date. Radiation will not interfere with the functioning of the engine or any other mechanical or electrical equipment aboard.

**11. CONTAMINANT — RADIOACTIVE SAND.** If possible, use a material which will simulate fallout in order to gain practical experience in the decontamination processes. Smearing mud on the aircraft has been tried, but without radioactive material in the mud, DECON crews cannot be sure of complete removal. Therefore, obtain a contaminant which will provide a few milliroentgens of gamma and beta radiation. Such a material is available in the form of uranium-ore sandstone, which is finely ground and ready to use. It will take about 10 pounds of this to conduct one exercise on a light aircraft. Arrangements can be made with the Homestake-Sapin Partners, P.O. Box 98, Grants, New Mexico, to organize one central distribution point in each state so that you can place your order with that distributor. Your State Department of Aeronautics or the Federal Aviation Agency General Aviation District Offices will be able to advise where this distribution point is in your state. The cost of this radioactive sand, plus shipping charges (motor freight), will be approximately \$1 to \$1.50 for 10 pounds.

**12. CERTIFICATE OF ACHIEVEMENT.** Some organizations may wish to give an award to their members in recognition of completion of preparatory training and successful execution of this exercise. A suggested format for such a certificate is shown on page 20.

# Certificate of Achievement

\_\_\_\_\_  
AWARDED TO

\_\_\_\_\_  
*for* \_\_\_\_\_

*at* \_\_\_\_\_

*Awarded this* \_\_\_\_\_ *day of* \_\_\_\_\_ 19 \_\_\_\_\_

\_\_\_\_\_  
ORGANIZATION

\_\_\_\_\_  
AUTHORIZED SIGNATURE

## Appendix II. GLOSSARY

**Alpha Particle**—A particle emitted spontaneously from the nuclei of some radioactive elements. It is identical with a helium nucleus, having a mass of four units and an electric charge of two positive units. It travels only a few inches, even in air, but can be very harmful if ingested by breathing or taken into the blood stream through an open wound.

**Attenuation**—The absorption or stopping of some of the radiation as it passes into or through solid materials.

**Beta Particle**—A charged particle of very small mass emitted spontaneously from the nuclei of certain radioactive elements. Most, if not all, of the direct fission products emit (negative) beta particles. Physically, the beta particle is identical with an electron moving at high velocity. The beta particle is the cause of beta burns to the skin, which may be very serious.

**Buffer Zone**—An area that has been decontaminated immediately beyond and in addition to the intended working area.

**Clean Area**—One in which decontaminating measures have been taken to reduce the amount of residual radioactivity.

**Contamination**—Deposit of radioactive material on the surface of structures, areas, objects, or personnel following a nuclear (or atomic) explosion. This material generally consists of fallout in which fission products and other weapon debris become incorporated with particles of dirt, etc. Contamination can also arise from the radioactivity induced in certain substances by the action of neutrons from a nuclear explosion.

**Cross-contamination**—The contamination of a previously "clean" area by radioactive material which is windblown, or tracked on shoes or vehicle tires, etc.

**Decay**—Sometimes referred to as "natural decay," is the decrease of any radioactive material with the passage of time.

**Decontamination**—The reduction or removal of contaminating radioactive material from a structure, area, object, or person. Decontamination may be accomplished by:

(1) treating the surface so as to remove or decrease the contamination;

(2) letting the material stand so that the radioactivity is decreased as a result of natural decay;

(3) covering the contamination to attenuate the radiation emitted.

Radioactive material removed must be disposed of by burial on land or at sea, or by other suitable methods.

**Dosage (dose)**—A total or accumulated quantity of ionizing (or nuclear) radiation. A dosage can be measured by reading a pocket dosimeter or it can be calculated by multiplying the hours of exposure times the rate of radiation, which is expressed in terms of roentgens or milliroentgens per hour.

**Dose Rate**—As a general rule, the amount of ionizing (or nuclear) radiation to which an individual would be exposed or which he would receive per unit of time. It is usually expressed as roentgens or milliroentgens per hour. The dose rate is commonly used to indicate the level of radioactivity in a contaminated area.

**Dosimeter**—An instrument for measuring and registering total accumulated exposure to ionizing radiation (pronounced — dosímeter).

**Gamma Rays (or Radiations)**—Electromagnetic radiations of high energy originating in atomic nuclei and accompanying many nuclear reactions, e.g., fission, radioactivity, and neutron capture. Physically, gamma rays are identical

with x-rays of high energy, the only essential difference being that the X-rays do not originate from the atomic nuclei, but are produced in other ways. Gamma rays probably constitute the greatest threat in radioactivity and are the main reason for decontaminating—to remove the source of this type of radiation.

**Milliroentgen (mr)**—A one-thousandth part of a roentgen.

**Monitoring**—Procedure of locating and measuring radioactive contamination by means of survey instruments which can detect and measure (as dose rates) ionizing radiations. (The individual performing the operation is known as a monitor.)

**Radiation Levels**—Measure of ionizing radiation at specified periods, usually read from survey meters as—mr/hr. or r/hr.

**Radioactivity**—The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays, from the nuclei of an unstable isotope. As a result of this emission, the radioactive isotope is converted (or decays) into the isotope of a different (daughter) element which may or may not also be radioactive. Ultimately, as a result of one or

more stages of radioactive decay, a stable non-radioactive end product is formed.

**Roentgen**—A unit of exposure dose of gamma (or X-) radiation. Survey meters and dosimeters show readings either in roentgen units or milliroentgen units.

**Stay Time**—The period of time personnel can work or stay in an area at the existing dose rate of radiation without exceeding the prescribed maximum dose.

**Shielding**—Any material or obstruction which absorbs (attenuates) radiation and thus tends to protect personnel or materials from the effects of a nuclear (or atomic) explosion. A moderately thick layer of any opaque material will provide satisfactory shielding from heat radiation, but a considerable thickness of material of high density may be needed for nuclear radiation shielding.

**Survey Meter**—A portable instrument, such as a Geiger Counter or ionizing chamber, used to detect and measure nuclear radiation. These measurements are in terms of the rate of radiation, either roentgens per hour or milliroentgens per hour.